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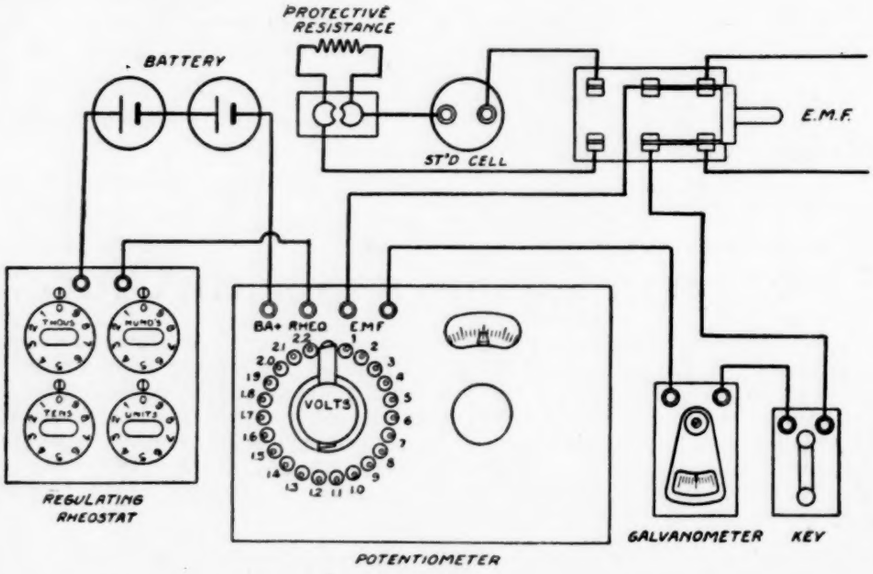

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THE MESSAGE OF THE BIOLOGIST[1]

IT is eminently fitting that we biologists, like virile swarm spores, should periodically come together in a holiday spirit of mutual exchange, and after giving and receiving our messages, go back to our life work, reinvigorated and reoriented, to prepare for another brief period of social conjugation.

The messages we send to one another will have little carrying power, and little influence on the receiver, if they are not specific in content, limited in scope, and securely wrapped up in the precise technical terms of our own familiar code.

On the other hand, the biologist would be wholly lacking in social instincts if he failed to recognize that he also has a more comprehensive message for the layman, who is largely dependent on the biologist for his working knowledge of the great domain of nature-life, and by whom the biologist is provided with the necessary means of existence.

This larger message must have a different vehicle. It must first be summarized, digested and metabolized into the vernacular, before it can circulate through the body of social life, reach its terminals, and there accomplish its strengthening and rectifying purpose.

We may well ask ourselves whether we have such a message to give, and if so, what it is, and who, or what, is our authority. And by "we," I now mean all of us, not merely the biologist, but the astronomer, geologist, chemist, physicist and psychologist, for we are what we are to-day because of the underlying community of our methods and purposes, and because, in our concept of evolution, we acknowledge the same mental sovereignty.

This concept, of which we are the trustees,

[1] Address of the vice-president and chairman of Section F, Zoology, American Association for the Advancement of Science, St. Louis, January 31, 1919.

initiated in man a veritable intellectual mutation, which is now rapidly expressing itself in new phases of social action, and in the emergence, like the parts of a growing embryo, of new types of social architecture. It is our duty to interpret this concept, and to see to it that its real significance is understood, and rightly used in social growth.

The social metamorphosis which historians call the renaissance was largely due to organic improvements in the system of educational circulation and the transmission of mental possessions from man to man. Learning was democratized by translating the bible and the classics into the vernacular, and by this betterment in transmission across time and space, the profits of a dead past were made to flow more freely into a living future, making those profits in some measure the mental heritage of the common people, and their enduring germinal possessions for self-constructive purposes.

In this accelerated social growth, the base line for the orientation of human conduct, and for the measurement of right and wrong, good and evil, was the bible, the classics, and the divine right of civic and religious leadership. The power and stability of these external directive agencies was universally acknowledged, the source of their authority unquestioned, and like radiant beams, their trophic influence was formally expressed in the prevailing architectonics of social procedure.

We are now witnessing, incident to a new birth of social vision, a new social convulsion, much more significant than that of the middle ages, in which science, and especially biological science, unconsciously played, and is still playing, a very important part. For when we recognized a new source of authority in lawful nature-action and in evolution, the old base line for the measurements of human conduct vanished, and many of the old bonds of social allegiance were destroyed; and now we are asked: What shall be the new compulsion to constructive social action, and on what authority can we stay the march of anarchy?

And you, as biologists and American men of science, can not shirk the grave responsibilities of social leadership now thrust upon you, for it requires little gift of prophecy to forsee that America is destined quickly to become the world's chief center of biological learning, as she is to-day the center of the broadest sympathy with human life and nature.

Perhaps it may clarify our vision if we first ask, not what biology is, but what science, as a whole, does, and what she tries to do. It will little help us to enumerate all the sciences, or be told there is "pure" science and applied science; science experimental, and descriptive. Behind and beyond all these varied aspects of science there must be common motives, and common purposes in the scientists, if we are rightly to include them as intelligent beings in the same class.

Let us therefore precipitate and remove these adjective purities and impurities, and you will then agree with me, I believe, that there still remain in science several overlapping functions and purposes. First to explore and to chronicle. To that end, she aims to discover what things are contained in nature, where they are, what they do, what the order is, step by step, of their coming in, their growing up, their going out. And then to memorize, to conserve her mental possessions, to register, in convenient and enduring symbols the result of her explorations, for future usage. Second, to compare and explain. To that end, she aims to discover why things are as they are, in what respects they differ, in what they agree, how one thing influences another, constructively, or destructively, and to distinguish the right ways of doing things from wrong ways. Her third function is to do things rightly. In that respect, she is artistic, architectural. To that end, by conforming her ways of doing things to nature's ways, she aims to create, and to conserve, and to use her records and her knowledge of right and wrong profitably.

Thus three qualifying motives pervade science: the acquisitive, the ethical and the moral. She seeks knowledge through experience, wisdom through understanding, and profit through obedience. One purpose is self-constructive, or egotistic, the other, self-

giving, or altruistic. Both are cooperative functions; in action, continuous; in rightness, cumulative; in effect, creative.

The renaissance of to-day has its chief creative impulse in the consciousness of evolution. This revelation of modern science, which we all acknowledge as our guiding star, has come to mean world-growth, or the progressive organization and architectural upbuilding of nature. Nature is now the source of our authority, and creative nature-action, as expressed in nature-growth, is the standard of all our values. Science is therefore compelled to express all her measurements in positive and negative constructive terms, which ultimately must be oriented in reference to this gradient base line of nature-progress, called evolution.

In this nature-growth, we fail to discover any gain or loss, either in basic constructive matter, or in energy. But gain there must be, if evolution is a reality. That gain is, in reality, a moral and ethical gain, or a gain in that creative action and constructive rightness which we call organization and directive discipline. There are no better positive and negative terms to express those gains, both relatively and absolutely, than the familiar terms, right and wrong, good and evil.

On this point, therefore, there need be no equivocation in our message. The profit in evolution is in better constructive action. By the conservation of these profits, nature augments her capital in constructive rightness.

But how is this profit made and conserved? That is the really vital question. Until it is answered there can be no underlying intellectual stability in human life, individually, or socially; no basic unity of purpose in human conduct. Here our vision is not so clear. Many of us believe that on this point we have no comprehensive message to give.

The most familiar attempts to explain how evolution takes place are restricted to special aspects of evolution, and are often epitomized in personal names, such as Darwinism, Lamarkism, Weismannism, Mendelism. Among us there are naturalists, morphologists, physiologists, and psychologists; breeders, experimentalists, and bio-chemists. And surrounding us on all sides are the physicists, chemists, geologists, and astronomers, with whom we must reckon, for their domains and their subject matter overlap ours in countless ways.

But unfortunately between all these workers there is little common understanding and much petty criticism.

Are we building out of aimless contributions to science a new Babel's tower of disjointed, slippery words, with nothing to hold them to constructive lines, and preserve the unity of purpose in our social architecture?

Perhaps the most comprehensive terms, although they have little meaning outside the organic world, are "natural selection," the "struggle for existence," and the "survival of the fittest." But granting their validity within the organic world, they have no definite moral significance. They convey no implication as to how man, or anything else, must act in order to exist, to say nothing of surviving. What is the fittest? Why is it fit? Why does it survive? If right combinations happen primarily by chance, why, or how, do they come to happen regularly? How can "right accidents" become cumulative, or lawful, or determinate, unless there is a saving, or more enduring, directive element in that something we call rightness?

When the layman makes his holiday call on his biological menagerie and points his umbrella at us, hoping to receive through that safety-first device a brush discharge of information, we fail to "come across" with illuminating answers to these very pertinent questions. But to conceal our low potential, and preserve our self-respect, we all resort to certain unintelligible sounds, or warning signals, according to the particular pen in which we have been bred and exercised, and which are guaranteed to scare away, or charm into inaction, the most intrepid questioner. One mumbles something about "environment" and "ecology," and crawls back into the bushes. Another wheezes something about "enzymes" and "vitality"" and goes on with his experimenting. Another climbs to the top of his

cage and yells "eugenics," while his mate in the corner faintly lisps "euthenics." Some particularly active youngsters jump into a revolving wheel, and every time it makes a complete revolution shout "chromosomes, chromosomes, chromosomes." A few old-moss-backs, a rare variety, mournfully harp on "morphology." And one majestic megatherium comprising all in one, coughs up an "energy complex," followed by a prolonged roar, in several volumes, in which one can distinguish the words "action, reaction, and interaction." The clergymen, senators, and Bolsheviki, with their retinues of lady friends, exclaim "How wonderful, and so true." Life indeed is complex, energetic, and full of actions, reactions, and interactions! And all of them deeply impressed, go back to their deadly work, and act, and believe, if at all, just as they did before.

After they are gone, all the animals agree that no one has any right to bother real, simon-pure scientists with such fool questions. Let them go to—well, Where? To Germany? To Nietsche, Bernhardi, and Treitsche? To the militant philosophy of dominion, to a half-witted selfishness, in politics, commerce, and kultur, frankly upbuilt on the doctrine of the survival of the fittest, the fittest universally acknowledged, by themselves, to be the Germans and their system?

Or to the spiritualists, anthropomorphists, and sentimentalists, who see nothing clearly in the mirror of nature but a distorted image of themselves?

Or to Huxley and his "I don't know" followers, who can discover no ethics or morality in nature-action; neither warning nor invitation, nor directive discipline, but merely a drab, unoriented neutrality of "unmorality," leaving man nothing but himself with which to orient himself; leaving him to create his own system of ethics and morality out of his own inner consciousness?

The biologist has found no evidence for the broad assumptions of these philosophers. In nature, he sees no one-sided dominion of the strong over the weak, or the weak over the strong; no special privileges; and no freedom from obligations. Neither does he see any warrant for puling sentimentality, nor any expectation of an unaggressive neutrality in nature-action.

Nature, so far as we have been able to discover, is an enduring, self-constructive system, gaining and preserving her gains, in a definite way, according to her own system of ethics and morality. In so far as nature-growth is manifest in evolution, we can not deny that at least to that extent her ethics are constructive and her morals saving.

Man's constructive and saving principles can not be otherwise, without severing all his bonds with nature-action in a futile attempt, like that suggested by Huxley, to set up an anarchistic "imperium in imperio," or a Bolshevistic "microcosm within the macrocosm."

I can not believe we have reached that parting of the ways, for man's highest activities are all too clearly but extensions of nature's ways and means of creating and preserving her products, in which man uses whatever intelligence he may have, and the cultural implements he has constructed, as special instruments to attain his ends.

The specific gravity of the western variety of biologists will not let him float in a vacuum of cosmic mysteries with the Hindoo; and he does not care to wallow in a quagmire of metaphysics with the Greek. He gladly plants his substantial mental feet on the first firm substratum he can reach. And even though that substratum be nothing more than the molecular quicksands of physics and chemistry, it safely leads him to the rising shores of hard realities.

But now that we biologists, as evolutionists, feel reasonably safe in our storm-proof shelters of established facts, the spirit of adventure again leads us forth to wider excursions, and we ask ourselves whether it is possible to reduce all the constructive processes of nature to a simple formula, which can be expressed in familiar terms of universal human significance? This is a venture doomed apparently beforehand to defeat, for it takes us back again to the most ancient beaches of human controversy, strewn with the wreckage of all man's early and late

attempts to launch a religion, or a philosophy, that will stand the test of experience.

And all these mournful wrecks are jealously guarded by marooned mariners of hope, and their beach-combing followers, who show no mercy to intruders. But modern science, which has wisely built on firmer, though drier ground, must ultimately extend the foundations of all of her out-housings down to the low water mark of this old shore, and while the attempt is fraught with danger, it will ever be an inspiring task for those engaged in the process of social reconstruction that now lies before us. I know of no other engineers whose occupation should better fit them for leadership in this task than the biologists, occupying, as they do, a central strategic position in relation to chemistry and physics, geology and astronomy, sociology and the humanities.

When to this end, we examine, as best we may, the attributes of these basic, chemical elements of nature's substance, we find in them, as in human social atoms, a potential constructive and creative power which becomes clearly manifest in the familiar processes of chemical action. In that process we are compelled to assume, if we are willing to assume anything, that some influence, or effect, we know not what, or how, is exercised by one element on another, the result of which may be the formation of a new unit, or compounded individuality, with a new style of architecture of its own. Coincident with this construction, the former attributes of the constituent parts vanish, and in the new unit a different attribute appears which was not there before.

We may profitably translate this constructive process into the vernacular, without, I trust, seriously offending the properties of the purest scientist, even though the words may savor of morality.

We may say, for example, that when the right chemical elements are in the right relations to one another, or if they are moved into them, or placed there or if these elements themselves find the right relations by chance, or otherwise, cooperative action between them then takes place automatically, or under a compulsion neither can resist, and something new is created. In this cooperative action, each element evidently does something, or gives something to the other, and receives something from the other. It is in fact apparently a clear case of creative action through mutual subjection and mutual service—not necessarily service for each other, because for all we know these elements may be the original anarchists and would much prefer neither to give anything to anybody, nor receive anything from anybody—but for the molecule so created.

In this creative process, the essential factors are, unity, mutual service, mutual discipline, and some sort of constructive rightness. When these conditions are fulfilled, something new is created, and these anarchistic elements then become, perforce, altruistic agents, or accessories, to some ulterior creative act, in which they may or may not be interested. In spite of themselves, by their mere existence, they are compelled to act for something beyond self, and in doing so they cease to be anarchists and become more or less orderly servants in a staid molecular society.

Mr. Molecule, therefore, is created by the mutual services and directive discipline of his constituent atoms, or elements, and by his home surroundings, all acting cooperatively to give him birth. In his creation, he becomes endowed with a sovereign quality of his own, subject to the sovereignty of his outer world. He endures as long as those cooperative services are rightly performed, and the discipline rightly maintained, and no longer. His existence, therefore, is contingent on the performance of these services, and on the existence of some degree of rightness within himself, and outside himself; and that molecule which does survive has preserved within its makeup some measure of that rightness. In that measure of cooperation and rightness lies the fitness of his constituents, and the selective agency in the evolution of the molecule.

But the molecule thus peremptorily set up in business for itself, and without being consulted in any way as to his own wishes in the matter, has his own work in the world to do,

subject to his own specific attributes and external compulsions. This new anarchist, by force of circumstances, may be compelled to help in the construction of proteids to be used by some future plant or animal life, even if his anarchistic soul does rebel at the performance of such useless altruistic labor, and at such unwarrantable interference with his freedom of action.

If we now make a momentary excursion toward the other extreme of nature-action, into the domain of the astronomer, we apparently find the same constructive, selective, and saving agencies at work that are manifest in the upbuilding of the molecule, only the system and its component parts are larger, the time and space factors greater, and the unknowable movers have different names.

Here the cooperative agencies are the sovereign cosmos, and the sovereign individualities it contains. These solar systems, with their constituents suns, planets, and satellites, and their subordinate elements, are grouped in partially visible architectural entities, suggesting the wholly invisible molecular entities of physics and chemistry.

The gains in this cosmic action-system are formulated in sidereal architecture, and the continuity of its constructive services is manifest in the stability of its organization. The morphology of the heavens, like that of molecules and living organisms, is not only an index of past and present physiologic action, but an assuring prophecy of future action. Without this forward and backward aspect, along a gradient line of progressive nature-action, science itself could not exist, for there would be no base line for the profitable orientation of intelligent thought or action.

In each of these larger sidereal units, and systems of units, is embodied the summed up profits of past cooperative actions. In this self-construction lies the egoistic phase of these individualities. The ulterior altruistic services to which they are accessories are in some measure apparent in the terrestrial conditions under which, without our consent or approval, we now exist. So let us get back to earth again, where these agencies have made life and constructive thought a possibility, and have rigidly defined its impossibilities, whether we like these invitations, restrictions, and compulsion of nature's discipline, or not.

In the terrestrial world, the most convincing and familiar example of creative unity through cooperative action, is the living organism. But plant and animal life stand on, and in, the altruistic achievements of the physical world. They are pensioners of the past, using both the oldest and newest instruments of nature in their self-construction. The individual plant, or animal, is the product of its cooperating elements, cells and organs, and its environment, and is itself a cooperative agent in that environment. It is subject to its own sovereign attributes, as well as to those of its constituents and its habitat. The individual gain is everywhere contingent on the general. The plant can not long endure without the animal, the male without the female, and neither without their retinues of other servants. They exist, as they do, because of these mutual services, within and without, past and present. Their profit is in service betterments: their working capital, past betterments conserved.

In this phase of nature-action, the cooperative system is formless, elastic, and democratic. Plants and animals are the actor-units, widely separated it may be, in time and space, but everywhere intermingled regardless of high or low degree. And the system now assumes the familiar give and take of predatory life and reproduction, where consumer and consumed, parent and offspring, egoism and altruism, perform reciprocal functions in the universal metabolism of nature-life.

Consider, for example, the nut, the mouse and the cat.

If the mouse destroyed all the nuts, it would destroy itself. Its interests are best served when nuts are encouraged. If it had intelligence, it would cherish and preserve them. If it had the necessary cultural implements, it might profitably spend its spare time and energy in producing more and

better nuts. Not even a "nut" could reasonably object to that. On the other hand, the cat is an efficient educator. It teaches the mouse to confine its attention to its own affairs, and both teacher and pupil are the better for that.

And when the mouse is about to die, and is brought to earth, it does not wholly go to waste. A percentage of him goes to make another nut, and a percentage helps to make another cat, which without the one and the other could not exist. And finally nature levies a tax upon the cat, and in due season the cat pays his taxes.

By virtue of this rigorous nature discipline, which prescribes when, and how, and where, the nut, the mouse, and the cat may act, and what they must, and must not do, each in its own way makes a living, as many others like them have done in similar ways before, a sufficient testimonial to the constructive and saving virtue of the system.

But this is only one part of this system of give and take. The plant, the mouse, or the cat, as an individual, not only gets, or receives enough income from all sources to pay his personal running expenses, but on the whole, each in his own way, makes a profit. Part goes into alterations, repairs and additions, or into what we call growth. But there is always a definite limit to individual holdings, or to the growth of every individual system, which is peculiar to itself. When that limit of cohesion is reached, or approached, the surplus overflows into other individualities and becomes their possession.

Much of this surplus of the profiteer, which for him is unusable, is scattered right and left with astounding prodigality, and this unwilling altruism on his part becomes one of the chief sources of income to life at large. But an adequate percentage becomes a special entailed endowment to a new individual, similar to the first, thus setting up a substitute, or a direct lineal descendant in the business of life, giving him a fixed capital in germinal materials, quick assets in germinal food-stuffs, with containers and protective envelopes, all rightly constructed and arranged, and the whole package so located in time and space by the administrators of these estates as to insure for it, in the long run, a new life of adventure among the hazards and inviting opportunities of the outer world.

Thus in this larger spongeoplasmic fabric of nature-life, visible only to the more comprehensive instruments of the mind, kingdoms and classes, races and species, young and old, the physical and organic entities of the living and the dead, are unconscious partners in a common system of cooperative action. In this social metabolism across the larger reaches of time and space, each unit, in the reciprocal egoism and altruism of life and death, plays its respective anabolic and catabolic functions, and thereby gives the system, as a whole, its self-sustaining, vital power.

Through the shifting patterns of this growing fabric, we most clearly see the converging threads of genetic lineage, the long, gradient lines of alternating youthful egoism and parental altruism, on the one hand vanishing in the primordial life that has its issue in the terrestrial loom, and on the other, radiating into the abyss of future possibilities. Everywhere shot through and across these more rigid hereditary lines are those which mark the sinuous course of predatory action, and other actions less discriminating. Thus the whole system is woven into that variegated plexus of success and failure, tragedy and comedy, joys and sorrows, good and evil, which makes up the cooperation functions of life and give it creative unity.

And then man, a new nature-anarchist, the most modern pattern in this moving-picture fabric, makes his appearance on the screen, and surrounded by his satellites of cultural instruments, and with both positive and negative poles of his very material self flaming with the auroras of intelligence, attempts to set this system which gave him birth to rights.

He is little conscious of the source of his own endowments, or that his ethics and morality, as manifest in his sporadic outbursts of social philanthropy and benevolence, are not his own institutions, but the compulsory application of world-old constructive principles to his own peculiar affairs. Nor is

he fully conscious that his boasted material inventions and discoveries, his canoes and battleships, his ovens, highways and machinery, his microscopes, telephones, and telescopes, his commerce, literature-science, and art, are but improvements, or enlargements, outside himself, of his own internal organs and functions, and that he must use these cultural instruments if he would use them constructively, in precisely the same ways his vital organs are used in his bodily growth and preservation.

In their functioning, these cultural instruments extend, deeper into time and farther across space, the power of his sense organs to discriminate between good and evil, and increase the range and velocity of the load his muscles, blood vessels, nerves, and other bodily organs can move, or carry. In other words they serve to increase the rate and diversity of the mutually profitable exchange, mental and physical, between the human molecules of social life, and between man and nature. They alone give man's social life its cooperative unity and power, just as the cooperative action of molecules, cells, and organs give unity and power to his body. Their saving and constructive action is contingent on the growth and right usage of intelligence, as the construction and preservation of his body is contingent on the evolution of right reflex actions and instincts.

And now, in this twentieth century of the historian's calendar—when the human blastoderm, for the first time in cosmic evolution, has practically enclosed the terrestrial egg, filling in all the habitable surface of this cosmic yolk-sphere, establishing its capillary network of highways, and its nerve plexus of communication, joining its racial blood-islands and national placodes into one organism —humanity has ceased to be a germinal potentiality, or a mere vision of the prophets. It has become a present and very obvious reality, and the academic flickerings of the philosophic auroras are now sufficiently luminous to be visible, as practical questions, to the politician. Indeed there is still hope that some rays may eventually pass the threshold of senatorial sensibility.

But the man of normal social instincts and average intelligence, in spite of himself, is now compelled to recognize this unity in human life and nature, and the dependence of that unity on the fulfillment of mutual rights, of mutual services, and mutual obligations. In this more humble state of mind, he does not now ask "What will I do?" but "What must we do?" to preserve social life and social structures. What is our protection against the will to destroy? With destructive agencies everywhere now at hand for those who have the will to use them, What shall be the compulsion to constructive action?

The answers to these questions can not be found in precedents, for there are no precedents in the whole history of evolution for man's present social conditions. The solution must be found in the intelligent application of the elementary principles of ethics and morality, principles which have their roots in the biological and physical sciences.

We must not accept Huxley's despairing assertions that "cosmic nature is no school of virtue, but the headquarters of the enemy of ethical nature," and that "the cosmic process has no sort of relation to moral ends." To do so we should have wholly to ignore the manifest creative power in cosmic action. We may surmise, from internal evidence, the irritation that provoked Huxley's brilliant but unconvincing dialectics, and it may be said that his point of view then, and the chief target of his attack, is not ours now.

And surely it is not for us "to fight the cosmic process" even under a fighting Huxley; nor on the other hand need we accept the stoical philosophy of protective mimicry and regard "living according to nature as the whole duty of man"; nor need we be horrified at the thought of ethics as "applied natural history."

Rather is it our duty to understand nature-action and to cooperate with it; to distinguish between the minor tactics of evolution and the grand strategy of evolution, and with our own peculiar instruments be willing and happy agents in its consummation. Man has

but his animal organs, his cultural implements, and his intelligence, or his knowledge of right and wrong constructive ways to work with. The more those instruments are augmented, the better he can direct nature's constructive agencies to his own egoistic ends, and in so doing, man himself then unwittingly becomes a new and better altruistic agent in evolution.

We scientists, conscious of our purpose as constructive social agents, have three broad fields of activity open to us, as already indicated in defining the various functions and purposes of science. First, investigation, or the discovery of nature's ways and means of creative action. This is the ethical side of our work. Second, the constructive usage of these ways and means, or their application to the growing demands of social life, and their usage in the regulation of human conduct. This is the moral side. And, third, the conservation of our ethical and moral gains through education. The first two we may now ignore, for their significance is duly appreciated and their future is promising. But the educational side of our work is in a very serious condition, and it may even now be too late to avoid disaster. It little matters how much we may develop either our technique, or the spear-head of our research, if the so-called common people still have the ghost-hunter's paleolithic mental attitude toward natural phenomena, and their leaders a similar attitude toward social problems.

No social life can endure that is not under some common compulsion to united action. With the growth of the spirit of freedom and democracy, and the absence of any commonly recognized dictatorship in church or state, that compulsion can come only through a common understanding of the elemental necessities of social life, and through that sense of personal benefit and personal ownership in social institutions which alone can create the will to cherish and protect them.

The compulsion of elemental intelligence, acting in social unison, can alone provide the enduring directive and cohesive power essential to social cooperation. Man's will to create can be steadfast in purpose only when his intelligence becomes stabilized in its trophic attitudes, and rightly oriented to elemental realities. Man, stumbling in ignorance, must be bandaged with restrictions and propped up with crutches of force. A nation, pricked by the poisoned shafts of a lying propaganda, will dissolve in anarchy, though the armies and navies of the world have failed to break it.

In our education, we continually over-emphasized social rights and individual freedom of action, and ignore the obligations essential to partnership in any social or constructive compact. It is not without significance that ordinary people, like you and me, can discover no specific mandate in the Constitution of the United States. It broadly defines what the state does, or will do, in certain contingencies, and what its citizens may, or may not do, but says nothing about what the citizen must do in return for what the state does for him. The absence in citizenship of a formal and specific contract, defining a common purpose and recognizing mutual liabilities and mutual benefits in its attainment, is in marked contrast with modern business procedure, as well as with almost every other form of intelligent cooperation. It is, therefore, not surprising that an international covenant for the specific purpose of reducing the danger of international wars to a minimum, in which an attempt is made to define national rights and obligations in that undertaking, has a strange and unfamiliar sound.

The absence of this covenant principle is noticeable in almost every phase of modern education. Science, even, does not formally recognize a covenant with nature, although nature virtually says to man "Know me, and serve me, and I will serve you." Much of our biological teaching is like a shop window display of nature's competitive goods, with a varied assortment of human notions thrown in, but with no guarantee as to their significance, or quality, or usefulness. The pedagogical barker, seldom having convictions of his own, proudly displays the impartiality of his "purely scientific" attitude, and leaves the callow purchaser to decide for himself

which trinket he will select for his mental adornment.

Perhaps all of us can get together again on common ground by putting our concepts of nature-action into simpler, more comprehensive formulas, universal in application, and somewhat as follows. In so far as we have a right to assume that purposeful action is involved in any constructive functioning whatever, or in anything that has been accomplished, we may assume that the purpose, or grand strategy in nature-action, is evolution, or self-construction, or growth. To that end, serviceable agents must first exist, or be constructed, in which is resident a basic right to receive service, and a basic obligation to give service. As all constructive action is contingent on the fulfilment of these mutual rights and obligations, the categorical imperative to existence is mutual service.

As corollaries to this categorical imperative, the following compulsions are laid upon these constructive agents. In all sustained constructive action there must be: (1) A mutual directive discipline, or mutual adaptation; that is, a mutual subjection, and yielding to one another's influence. (2) An individual freedom of opportunity for self-constructive, or egoistic action, within rigidly circumscribed limitations. (3) Mutual service or cooperative action, in which, soner or later, the profits of egoism must be surrendered, through altruism, to some ulterior creative act. (4) Conservation of these profits as an accumulating capital in constructive rightness, and its endowment to other individualities for usage in further constructive action.

In that phase of cosmic evolution which we call social growth, science and religion are the outstanding cooperative agents. They better serve their ulterior purposes the better their mutual services, and the better their mutual adaptation of thought and act to creative ends.

Science and religion always have asked, and doubtless always will ask, the same fundamental questions. What creates, what preserves, and what destroys the products of nature, and how may man profit thereby? The answers, whatever they may be, must ultimately be expressed by them in essentially equivalent terms, their verification sought in constructive action.

The large element of unpredictable returns resident in all phases of nature-action demands trial; creative turns justify the experiment.

These unsuspected potentialities are revealed in the triumphs of nature's creative art and thus confirm her independence of established laws and precedents. Therein is the source of man's undying hope and faith, his abiding impulse to endeavor.

William Patten

Dartmouth College

ON NIPHER'S "GRAVITATIONAL" EXPERIMENT AND THE ANOMALIES OF THE MOON'S MOTION[1]

From his assumption that matter is entirely electrical, Fessenden concluded[2] that the atoms in the interior of solid bodies are charged electrically, contrary to a common conception that a static charge resides wholly on the surface. Fessenden's assumption has now been completely confirmed by Professor Francis E. Nipher's experiment with an electrified Cavendish apparatus,[3] which shows that when thin electrified shells of metal are substituted for the large leaden spheres, no effect is produced on the inner small suspended spheres, protected by a metal case, when the electricity is applied. This, of course, simply corroborates Faraday's "ice-pail" experiment. But when the large leaden spheres are restored to place and electrified, the electricity gradually soaks in, and after about half an hour this interior charge of the atoms has accumulated sufficiently to produce an electrical repulsion of the small spheres, greater than their original gravitational at-

[1] This paper was read at the twenty-second meeting of the American Astronomical Society at Harvard College Observatory, August, 1918.

[2] *Electr. Soc.*, Newark, 1890; *Electr. World*, August 8–22, 1891.

[3] "Gravitational Repulsion," *Transactions of the Academy of Science of St. Louis*, Vol. XXIII., p. 177, 1917.

traction by the material of the unelectrified large spheres. Professor Nipher calls this a "gravitational repulsion," but this appears to be a misnomer. If the lead had really become *gravitationally* repulsive, it should also repel the earth, and the leaden spheres should rise up and float away. Needless to say, this is not what happens. Contrary to the usual conception of a static charge, *the electric charges have penetrated into the substance of the metal.* Since it is thus shown that a charge of electricity, which in other respects would not be distinguished from a static charge, has in this instance slowly been absorbed by the metal, permeating its substance, the thin metal of the protecting case can be no barrier to the transmission of such a charge as this, and the metal case no longer protects the inner balls of lead from directly receiving a corresponding electric charge of the same sign as that of the large spheres, and thus there is repulsion between the two, no matter whether the electrification be positive or negative. However, since the electric penetration progresses very slowly, the large spheres presumably take more time to charge up than the small spheres. Consequently, if after a preliminary application of one sort of electricity for a sufficient time to produce saturation, the electrification is changed to the opposite sort, we should expect that the electrification of the small spheres would change sign first, and for a while there should be electric attraction, or at least a progressively diminishing repulsion. Now this is exactly what takes place, though sometimes with rather vigorous tremors, as if the interior distribution of the electricity were not quite uniform and as though its unloading were spasmodic; but eventually, if the experiment endures long enough and the electrification is sufficiently powerful the signs of the electric charges become the same in both large and small spheres and the temporary electric attraction changes back to a repulsion. There are some anomalies connected with the orientation of the applied electricity when direct contact of brushes is the method of application, which possibly signify that the lead spheres are not entirely homogeneous for charges communicated in this way.

While the gravitational and electrical forces are intimately related, insomuch that a common entity—the electron—is presumably concerned in both, their modes of action and speeds of transmission appear to be entirely different. The electric phenomena which counterfeit gravitation in the preceding experiment, are irregularly variable and slow. Gravity is constant and its impulses so rapid in their transmission that their speed has never been directly measured. There is no reason to suppose that gravity is conveyed by electro magnetic vibrations with the speed of light, for these uniformly give repulsion, and not attraction; nor is the final action of the penetration of the electric charges other than repulsion, while, in spite of Professor Nipher's title, there is no evidence of any *gravitational repulsion.*

From the result of Nipher's experiment, we may infer that the penetration of electrons, emitted by the sun from time to time and entering into the substance of earth and moon, will produce a variable electric repulsion between these neighboring bodies, and it is conceivable that some of the unaccounted irregularities in the moon's motion may be produced in this way.

The positive electric potential of the atmosphere increases in an upward direction, at first slowly, then more rapidly, though sometimes quite irregularly, often attaining a value of tens of thousands of volts at a height of a few miles. This electrification of the air is the result of the ionization of some of its ingredients through absorption of the sun's rays. The ionization is greatest in the upper air, partly because the incoming rays are there rich in the ultra-violet rays which are the most efficient ionizers, and the upper layers are the ones which first take toll of the radiation before these rays have been depleted; but the electrification is also greater in the upper air partly because these layers are furthest from the surface of the ground and can not lose their charge by conduction to the ground as easily as the lower layers. Although air is a very imperfect conductor,

the section of this conductor being equal to the entire surface of the globe is enormous, compared with the distance to be bridged; and thus the minute specific conductivity of the air multiplied by the section and divided by the length of the path is still an appreciable quantity even locally, and a very large one taking the earth as a whole. Moist air conducts better than dry, and the electrification at a given altitude is on the average several times as great in winter as in summer, because the drier air of winter is a better insulator.

The following examples are from U. S. Weather Bureau observations at Drexel, Nebraska, in 1917 (e = mean pressure of aqueous vapor in the air up to the given height, measured in millibars; v = positive electric potential of the upper layer in volts).

Height Above Sea-level, Meters	Jan. 11, P. M.		Jan. 18, A. M.		Jan. 26, A. M.		June 12, A. M.		June 19, A. M.		June 23, A. M.	
	e	v	e	v	e	v	e	v	e	v	e	v
500	1.44	410	2.39	390	2.17	1,130	12.48	0	10.06	0	18.47	0
1,000	1.43	3,420	2.04	2,090	2.14	7,520	10.18	0	8.97	40	15.24	0
1,500	1.62	6,355	1.89	6,160	2.62	17,735	10.46	0	8.40	320	13.27	0
2,000	1.80	9,645	1.67	7,625	2.76	20,775	7.73	315	7.86	870	10.65	310
2,500	1.87	14,650	1.35	12,280	2.79	22,300	7.00	805	7.21	1,245	9.56	490
3,000	1.91	19,850	1.13	16,085	2.71	25,060	6.75	1,295	6.68	1,710	8.74	340
3,500					2.57	26,835	6.46	1,785	6.07	2,405	7.82	480
4,000							6.40	2,270	5.50	3,255	7.24	535
4,500									5.10	4,200	6.70	550

On the given dates in January, which are fairly typical, the average positive electric potential was 20,332 volts at 3,000 meters for $e = 1.92$ m.b., and in June a potential of 1,375 volts was found at the same height for $e = 7.39$ m.b. So far as ionization of water vapor is concerned, there should be more of it in June per unit volume of air; but in spite of this, the greater atmospheric conductivity at that time cuts down the potential to a much lower value than the winter one. Evidently there is continual conduction from the air to the ground. This does not neutralize the negative charge of the ground, partly because of the large electric capacity of the latter, but mainly because the prevalent negative charge of the earth as a whole is continually being restored. Except for convective uplifting of local bodies of air temporarily negatively charged by contact with the ground, these conditions of electric distribution in the atmosphere are fairly persistent. The two electricities are continually combining, but are as constantly replenished.

The incoming electrons from the sun may be absorbed by the upper air, but they serve to increase the absolute potential of the earth by a process which is independent of the radiant ionization; and as I have shown that there is conduction between the upper and lower layers of the atmosphere and adjustment of its ever varying charges, the increased absolute potential of the upper air is eventually, and probably pretty rapidly, transferred to the ground. Thus the ground receives its permanent negative charge from the sun; and in spite of all sorts of irregular electric variations in the intervening atmosphere, the permanent negative charge of the ground is maintained with only such minor fluctuations as occur in magnetic storms. In these, the showers of electrons received by the earth from the sun at times of great solar activity certainly penetrate into the earth's solid substance almost immediately, in spite of atmospheric obstruction, and produce electric "earth currents" of considerable magnitude. We must conclude that the absolute potential of the earth is continually varying.

Newcomb's investigations of the inequalities of the moon's motion[4] indicate the existence of unexplained fluctuations in the moon's mean motion—a great fluctuation possibly with a period of between 250 and 300 years,

[4] Monthly Notices of the Royal Astronomical Society, Vol. LXIX., p. 164, January, 1909.

though the change may prove aperiodic, and a lesser one of about 70 years. Professor Newcomb says:[5]

> Taken in connection with the recent exhaustive researches of Brown, which seem to be complete in determining with precision the action of every known mass of matter upon the moon, the present study seems to prove beyond serious doubt the actuality of the large unexplained fluctuations in the moon's mean motion to which I have called attention at various times during the past forty years.

And he concludes, after examining every known cause of motion, that "if we pass to unknown causes and inquire what is the simplest sort of action that would explain all the phenomena, the answer would be—a fluctuation in the attraction between the earth and the moon."[6] This is in line with my present suggestion, but as yet we have no certain knowledge whether there is correspondence between the supposed attractive change and the solar emission of electrons. However, the comparison which Professor E. W. Brown has made between the variation of the moon's mean motion in longitude and the fluctuation in height of the maxima of the sun-spot curve[7] lend considerable confirmation to the view that the 70-year period in the moon's motion is in fact due to a varying electric repulsion between the moon and the earth owing to the larger reception, by both bodies, of negative electrons when sun-spot maxima are highest and when, presumably, solar electronic emission is exceptionally great, with consequent slight reduction of gravitational control and loss of motion owing to electronic repulsion. We might suppose that the electrons thus received by our earth from the sun, form a fluctuating electronic "atmosphere," outside of the denser air, but attached to the planet. Nipher's experiment, however, favors the supposition that there is actual electronic penetration into the solid substance of the outer layers of the earth.

[5] *Op. cit.*, p. 164.

[6] *Op. cit.*, p. 169.

[7] See Report of the Australian meeting of the British Association for the Advancement of Science, *Transactions Sect. A*, pages 311 to 321.

Professor Brown says:[8] "With some change of phase the periods of high and low maxima correspond nearly with the fluctuations above," referring to his curve of the variations of the moon's motion in longitude, where negative values of the moon's motion-variation from the mean follow close after the high sun-spot maxima of 1780 and 1850, while positive lunar values (that is, increased speed from greater total attraction) are equally associated with the low solar maxima of the epochs near 1815 and 1885, or half way between the epochs of high sun-spot maxima. Nevertheless, as the electric hypothesis was then unbroached, Brown considered the connection open to doubt because, as he says, "it is difficult to understand how, under the electron theory of magnetic storms, the motions of moon and planets can be sensibly affected." But this difficulty which was felt when the only hypothesis in sight was that of some sort of *magnetic* effect, disappears in the light of the now known efficacy of electronic penetration. Similar, though much smaller variations, with apparently identical period, are found in the motions of Mercury and the Earth in respect to the sun, but in these there are some discrepancies, and until these are cleared up, the proposed explanation, though plausible and perhaps even probable, can not be considered as certainly established.

F. W. VERY

WESTWOOD ASTROPHYSICAL OBSERVATORY,
WESTWOOD, MASS.

[8] *Op. cit.*, p. 321.

FRANK PERKINS WHITMAN[1]

PROFESSOR WHITMAN was of New England stock. The Whitman (originally Wightman) family came to Massachusetts in 1632. The line of Whitmans has included three clergymen. The father of Frank was William Warren, early in life a lawyer, but later engaged in business, who died in 1902, at the age of eighty-two. Caroline Keith Perkins, the mother of Frank, died at the age of forty-one. She and the mother of President Taylor,

[1] Minute adopted by the Undergraduate Colleges of Western Reserve University.

of Vassar College, were sisters. Her father, Aaron Perkins, served the Baptist church as minister for over seventy years. The Perkins family also settled in Massachusetts early in the seventeenth century.

Professor Whitman was born and spent his boyhood years in Troy, N. Y. After attending a private academy, the high school, and also for a while a private home school in Pittsfield, he entered Brown University and graduated in 1874. He was a member of Alpha Delta Phi, Phi Beta Kappa, a Junior Exhibition speaker and on the commencement list. After graduation he taught in the English and Classical High School of Mowry and Goff for four years, at the same time pursuing graduate studies at Brown University, and received the master's degree in 1877. In the year 1878-9 he studied physics at the Massachusetts Institute of Technology, at the same time making astronomical observations with E. C. Pickering, and working on lenses with Alvan Clark. He spent the following year at the Johns Hopkins University. During this time he was associated with Mr. Newton Anderson, who later founded the University School in Cleveland.

In 1880 Professor Whitman was called to the professorship of physics at Rensselaer Polytechnic Institute at Troy, where he remained until he came to Cleveland. His work in Adelbert College and the College for Women began in 1886, and continued until 1918, when, after a year's leave of absence, he became professor emeritus. He acted as dean of Adelbert College from 1903 to 1906.

He was chairman of the physics section of the American Association for the Advancement of Science, and thus vice-president of the association, in 1898. His vice-presidential address was on the subject color-vision. Two years before he published a paper on the subject of the flicker photometer, an idea not original with him, but he developed its possibilities and it has since been perfected by others. His scientific ability was critical rather than creative. For this critical faculty there developed few opportunities, hence his scientific activities were confined mainly to college halls. He was not a research scholar and never wished to be considered one, but he did have a profound knowledge of the great problems of physics and astronomy, and he kept up with the research work done in these branches. He devoted much of his attention to the possibilities of lecture experiments as a means of instruction. The construction and administration of the physics laboratory naturally received much of his time and interest. He never failed in the mass of executive work which is required in a college, and in this field he showed the greatest capacity and usefulness. In addition to his minor interest in local organizations, he was a member of Sigma Xi, of the American Physical Society, of the American Astronomical Society and of the Illuminating Engineering Society. He received the honorary degree of Sc.D. from Brown University in 1900. He was a trustee of the University School of Cleveland, and took an active interest in its development.

During his long connection with Western Reserve, Professor Whitman endeared himself to his colleagues in an unusual degree by his unfailing courtesy and generosity, the charm of his personality, the wisdom of his counsel, and the absolute integrity of his conduct. A righteous man, whose ear was ever open to the voice of an enlightened conscience, he inspired complete confidence and made himself a trusted leader. He brought honor to his profession, happiness to his friends, a rich service to the university; and in the halls of memory, his figure will long remain a type of perfect faithfulness.

HORATIO C. WOOD

Horatio C. Wood, M.D., LL.D., emeritus professor of materia medica, pharmacy and general therapeutics in the University of Pennsylvania Medical School, died, January 3. The obituary notice in the *Pennsylvania Gazette* states that for three generations members of the Wood family have been on the medical faculty. Dr. George Bacon Wood, one of the founders of the Philadelphia College of Pharmacy, and an uncle of Horatio C. Wood,

was professor of materia medica at Pennsylvania from 1835 until 1850, and professor of the theory and practise of medicine until 1860, when he resigned. Dr. Horatio Charles Wood, Jr., is professor of pharmacology and therapeutics, having succeeded to one of the chairs held by his father when he retired. He is survived by these children: James L. Wood, Milford, Pa.; Dr. George B. Wood, Dr. Horatio Charles Wood, Jr., and Miss Sarah K. Wood.

Dr. Wood was born in Philadelphia, January 13, 1841, a son of Horatio Curtis and Elizabeth Head Bacon Wood. His first American ancestor, Richard Wood, emigrated from Bristol, England, in 1682, settling first in Philadelphia and afterwards in New Jersey. Horatio C. Wood was educated at Westtown School and Friends' Select School, and was graduated from the medical department of the University of Pennsylvania in 1862.

In his youth he developed a fondness for natural history and before studying medicine became a worker in the Academy of Natural Sciences, distinguishing himself by his original work. After spending several years in hospitals, Dr. Wood began private practise in 1865, making a specialty of therapeutics and materia medica, meanwhile continuing his natural history studies and publishing numerous papers on this branch of science, especially cell botany. In his early life Dr. Wood also was a student of entomology and published thirteen original memoirs upon the subject. He abandoned these studies after 1873 and devoted his whole attention to medicine.

He was appointed professor of botany in 1866 in the auxiliary faculty of medicine in the university which had been established and endowed by his uncle, Dr. George B. Wood, and held this position ten years. He also made a special study of nervous diseases and upon the organization of the University Hospital in 1874 was appointed clinical lecturer, becoming professor in 1875 and retaining this chair until 1901. He also was professor of materia medica and therapeutics from 1875 until he retired.

Dr. Wood was the author of numerous medical and scientific works including "Thermic Fever or Sunstroke," 1872; "Materia Medica and Therapeutics," 1874; "Brain Work and Overwork," 1880; and "Nervous Diseases and their Diagnosis," 1874. In cooperation with Professors Bennington and Sadtler he revised the United States Dispensatory.

Lafayette College conferred upon him the degree A.M., in 1881 and LL.D. in 1883. He received the degree LL.D. from Yale in 1889 and from the University of Pennsylvania in 1904. He was a member of many learned societies including the National Academy of Sciences, was president of the American Pharmacopœial convention from 1890 until 1910, and was president of the College of Physicians in 1902 and 1903.

SCIENTIFIC EVENTS

WATER-POWER AND DARTMOOR

As similar problems must frequently be solved in the United States, the following may be quoted from *Nature:*

The proposal to develop electrical energy from water-power on Dartmoor has led to a strong protest against interference with the amenity of the moor as appreciated by the lovers of solitary places. Mr. Eden Phillpotts first directed attention to the matter by a letter in the *Times* of December 10, in which he called on the Duchy of Cornwall, the landlords of Dartmoor, to act quickly "and help to create a body of Parliamentary opinion; otherwise the destructive and ill-considered enterprise may receive sanction from an indifferent House of Commons next session." A Plymouth correspondent supplied to the *Times* of December 23 an account of the scope of the proposed scheme, and on later days other writers expressed their strong disapproval of the project from local, engineering, or esthetic points of view.

The scheme of the Dartmoor and District Hydro-electric Supply Company is briefly to utilize the great rainfall and high altitude of Dartmoor in the generation of electricity at several power stations situated on different streams, to convey the current to the neighboring towns and villages for ordinary municipal purposes, and possibly to erect industrial establishments where current might be used for electrolytic or power purposes. It is claimed that this work will furnish needed employment for the population of the district,

provide a continuous and economical supply of electricity for lighting, traction and heating, reduce the congestion of railway traffic by diminishing the demand for coal, and generally increase prosperity and confer public benefits more than sufficient to counterbalance any interference with agriculture, fishing rights, or the pleasure of visitors to the Moor.

The general, and especially the local, public is not qualified to weigh the rival claims, and as things now stand Parliament must proceed by the old, cumbrous, and very costly method of hearing eloquent advocates and technical experts on all the points raised.

At present the whole question of the water resources, and especially of the water-power of the British Isles is being investigated by a committee of the Board of Trade, and on this account Parliament may be inclined to postpone the consideration of private bills dealing with water, if not of special urgency, until the committee has reported. There are few areas in England where an unused gathering-ground exists at an altitude allowing of the development of water-power, and it may well be considered inexpedient to allocate them finally before a hydrometric survey has been carried out to enable the available power and its cost to be calculated on a sure basis before work is commenced.

MEDICAL EDUCATION

THE Council on Medical Education of the American Medical Association, the Association of American Medical Colleges and the Federation of State Medical Boards of the United States will hold a congress on medical education and licensure at Chicago on March 1, 2 and 3. The program is as follows:

MONDAY, MARCH 1, 1920

Morning Session, 9:30 A.M.

Introductory Remarks by Dr. Arthur Dean Bevan, chairman of the Council on Medical Education, Chicago.

Dr. George Blumer, president of the Association of American Medical Colleges, New Haven, Conn.

Dr. David A. Strickler, president of the Federation of State Medical Boards, Denver, Colo.

"Present status of medical education," Dr. N. P. Colwell, secretary of the Council on Medical Education, Chicago.

Symposium on "The needs and future of medical education," Dr. George E. Vincent, president of the Rockefeller Foundation, New York City.

Dr. Ray Lyman Wilbur, president of Leland Stanford University, Stanford University, Calif.

Dr. Henry S. Pritchett, president, Carnegie Foundation for the Advancement of Teaching, New York City.

Dr. Harry Pratt Judson, president, University of Chicago, Chicago.

Mr. Abraham Flexner, secretary of the General Education Board, New York City.

Monday Afternoon, 2 P.M.

"The larger function of state university medical schools," Dr. Walter A. Jessup, president of the State University of Iowa, Iowa City.

"Full-time teachers in clinical departments," Dr. William Darrach, dean of Columbia University College of Physicians and Surgeons, New York City.

"Research in medical schools, laboratory departments," Dr. Oskar Klotz, professor of pathology, University of Pittsburgh School of Medicine, Pittsburgh.

"Research in medical schools, clinical departments," Dr. G. Canby Robinson, dean, Washington University School of Medicine, St. Louis.

TUESDAY, MARCH 2, 1920

Morning Session, 9:30 A.M.

"Graduate medical instruction in the United States," Dr. Louis B. Wilson, Mayo Clinic, Rochester, Minn.

"Interallied medical relations; qualifying examinations, licensure, examinations, graduate medical instruction," Dr. Walter L. Bierring, secretary of the Federation of State Medical Boards, Des Moines.

"Essential improvements in state medical licensure," Dr. John M. Baldy, president of the Pennsylvania Bureau of Medical Education and Licensure, Philadelphia.

"Interstate relations in medical licensure," Francis W. Shepardson, director of the Department of Education and Registration of the State of Illinois, Springfield.

Tuesday Afternoon, 2 P.M.

Reports on Medical Teaching from the Committee on Medical Pedagogy of the Association of American Medical Colleges.

Remarks by the chairman, Dr. W. S. Carter, dean, University of Texas, department of medicine, Galveston.

Anatomy: Dr. Charles R. Bardeen, dean, University of Wisconsin Medical School, Madison.

Histology and embryology: Dr. F. C. Waite, secretary, Western Reserve University School of Medicine, Cleveland.

Physiology: Dr. E. P. Lyon, dean, University of Minnesota Medical School, Minneapolis.

Biological chemistry: Dr. Otto Folin, professor of biological chemistry, medical school of Harvard University, Boston.

WEDNESDAY, MARCH 3, 1920

Morning Session, 9:30 A.M.

Pharmacology: Dr. C. W. Edmunds, assistant dean, University of Michigan Medical School, Ann Arbor.

Pathology: Dr. James Ewing, professor of pathology, Cornell University Medical School, New York City.

Bacteriology and parasitology: Dr. A. I. Kendall, dean, Northwestern University Medical School, Chicago.

Public health and preventive medicine: Dr. Victor C. Vaughan, dean, University of Michigan Medical School, Ann Arbor.

Wednesday Afternoon, 2 P.M.

Separate business meetings will be held by the Association of American Medical Colleges and the Federation of State Medical Boards.

SCIENTIFIC LECTURES

THE faculty of medicine of Harvard University offers a course of free public lectures, given at the medical school, Longwood Avenue, Boston, on Sunday afternoons, beginning February 1 and ending March 28, 1920. The lectures begin at four o'clock and the doors will be closed at five minutes past the hour. No tickets are required.

February 1. Child welfare. Dr. Richard M. Smith.

February 8. Smallpox and vaccination. Dr. Edwin H. Place.

February 15. Protection against infection in diseases other than smallpox. Dr. Harold C. Ernst.

February 22. Diseases of the teeth in relation to systematic disturbances. Dr. Kurt H. Thoma.

February 29. Pneumonia. Dr. Frederick T. Lord.

March 7. Some aspects of alcohol. Dr. Percy G. Stiles.

March 14. New conceptions of the structure of matter. Dr. William T. Bovie.

March 21. Health and industry. Dr. Cecil K. Drinker.

March 28. Some points of interest to the public in regard to medical education as brought out by the recent war. Dr. Channing Frothingham.

The trustees of the Ropes Memorial announce that the eighth course of lectures on botany is being given in the trustees' room at the Ropes Mansion, 318 Essex Street, Salem, Mass., by Professor M. L. Fernald, of Harvard University, on Thursday afternoons, at 4.15 o'clock, the subject being The Geographic Origin of the Flora of Northeastern America. The lectures are:

January 15. The maritime flora: the flowering plants of sea-margin salt marsh tidal estuaries and strands.

January 22. The coastal plain flora: the plants of sand hills; of Cape Cod; of eastern Newfoundland.

January 29. The deciduous forests: the Alleghenian flora and its history.

February 5. The Canadian forests: similarities and variations of circumpolar forest plants.

February 12. The actic-alpine flora: the contrasting ranges of the floras of the granitic, limestone and serpentine mountains of northern New England, Quebec and Newfoundland.

February 19. The cosmopolitan flora of the future.

The objects of the course are to present in brief outline the more striking features in the history of the floras of the northern hemisphere—their antiquity, probable migrations and wholesale extinctions in geological time; and to make clear why, unless the more sensitive and easily exterminated of our wild flowers are intelligently safeguarded, they are doomed to early extinction.

THE ILLINOIS ACADEMY OF SCIENCES

THE thirteenth annual meeting of the Illinois State Academy of Science will be held at Danville. The preliminary program is as follows:

FRIDAY, FEBRUARY 20

11 A.M. Business session. Reports of officers and committees.

2 P.M. General scientific session for the reading of papers.

5:30 P.M. Delegates and citizens assemble at Elks' Hall.

6 P.M. Academy banquet.

8:15 P.M. Public session of the academy in the Washington school and auditorium. Address by the president, "Alaska and its Riches." (Illustrated by lantern.)

9:30 P.M. Informal reception.

SATURDAY, FEBRUARY 21

9 A.M. General scientific session for the reading of papers.

1:30 P.M. Business session. Election of officers.

The Indiana Academy of Science has been invited to participate and will send a number of delegates as well as contribute to the program. The South American expedition conducted jointly by the University of Indiana and the University of Illinois will be discussed by the director, Dean C. H. Eigenmann, of the University of Indiana.

Amendments to the constitution providing for the affiliation of the academy with the American Association for the Advancement of Science and creating two classes of members, viz., national members and local members, have been unanimously accepted and will come up for final adoption.

GIFT OF THE CARNEGIE CORPORATION TO THE NATIONAL ACADEMY OF SCIENCES AND THE NATIONAL RESEARCH COUNCIL

THE Carnegie Corporation of New York has announced its purpose to give $5,000,000 for the use of the National Academy of Sciences and the National Research Council. It is understood that a portion of the money will be used to erect in Washington a home of suitable architectural dignity for the two beneficiary organizations. The remainder will be placed in the hands of the academy, which enjoys a federal charter, to be used as a permanent endowment for the National Research Council. In announcing this gift the report from the council says:

> This impressive gift is a fitting supplement to Mr. Carnegie's great contributions to science and industry.
>
> The council is a democratic organization based upon some forty of the great scientific and engineering societies of the country, which elect delegates to its constituent divisions. It is not supported or controlled by the government, differing in this respect from other similar organizations established since the beginning of the war in England, Italy, Japan, Canada and Australia. It intends, if possible to achieve in a democracy and by democratic methods the great scientific results which the Germans achieved by autocratic methods in an autocracy while avoiding the obnoxious features of the autocratic régime.
>
> The council was organized in 1916 as a measure of national preparedness and its efforts during the war were mostly confined to assisting the government in the solution of pressing war-time problems involving scientific investigation. Reorganized since the war on a peace-time footing, it is now attempting to stimulate and promote scientific research in agriculture, medicine, and industry, and in every field of pure science. The war afforded a convincing demonstration of the dependence of modern nations upon scientific achievement, and nothing is more certain than that the United States will ultimately fall behind in its competition with the other great peoples of the world unless there be persistent and energetic effort expended to foster scientific discovery.

SCIENTIFIC NOTES AND NEWS

DR. BURTON E. LIVINGSTON has been elected permanent secretary of the American Association for the Advancement of Science, to succeed Dr. L. O. Howard, elected president of the asociation. Dr. Livingston will retain the professorship of plant physiology at the Johns Hopkins University, and the office of the association will remain at the Smithsonian Institution.

DR. W. A. NOYES, head of the department of chemistry of the University of Illinois, has been elected president of the American Chemical Society.

AT the Cincinnati meeting of the Federation of Societies for Experimental Biology, presidents of the constituent societies were elected as follows: The American Physiological Society, Professor Warren P. Lombard, of the University of Michigan (reelected); the American Bio-chemical Society, Professor Stanley J. Benedict, of Cornell University;

the Society for Experimental Pathology, Dr. William H. Park, of New York City; the American Pharmacologists' Society, Professor Arthur S. Loevenhart, of the University of Wisconsin.

THE presentation of the Perkin Medal to Professor-emeritus Charles F. Chandler, of Columbia University, by Professor Marston T. Bogert, of Columbia University, took place at the meeting of the Society of Chemical Industry, at the Chemists' Club, New York City, on January 16.

AT a meeting held on December 1, Professor Thomas B. Osborne, of the Connecticut Agricultural Experiment Station, was elected an associate member of the Société Royale des Sciences Médicales et Naturelles de Bruxelles.

THE prize of $100 offered in 1914 for the best paper on the availability of Pearson's formulæ for psychophysics, to be judged by an international committee consisting of Professors W. Brown, E. B. Titchener and F. M. Urban, has been awarded to Dr. Godfrey H. Thomson, of Armstrong College, Newcastle-upon-Tyne, for an essay entitled "On the Application of Pearson's Methods of Curve-Fitting to the Problems of Psychophysics."

AT its last meeting the Rumford Committee of the American Academy of Arts and Sciences made the following appropriations: to Professor Frederick A. Saunders, of the Jefferson Physical Laboratory, one hundred and fifty dollars in addition to a former appropriation in aid of his research on Spectral Lines; to Professor David L. Webster, of the Massachusetts Institute of Technology, three hundred and fifty dollars in addition to a previous appropriation in aid of his research on X-ray spectra.

MR. ELMER D. MERRILL, who has been in charge of botanical work for the Philippine government since 1902, has been appointed director of the Bureau of Science. In addition to his duties as botanist, Bureau of Science, Mr. Merrill was chief of the department of botany, University of the Philippines, from 1912 to 1919, first as associate professor, later as professor of botany. In March, 1919, he resigned from the university in order to devote his whole time to the botanical interests of the Bureau of Science, was made acting director of the bureau in June, and director in December, 1919.

DEAN CHARLES FULLER BAKER, of the college of agriculture, University of the Philippines, takes a year's leave during 1920, because of failing health. He plans to spend a large part of this leave in the higher regions of the Philippines. His address will continue to be Los Baños, Philippine Islands.

MR. R. S. MCBRIDE, engineer-chemist of the National Bureau of Standards, resigned on January 15, to become the engineering representative in Washington, D. C., of McGraw-Hill Company of New York City. His first work will be in connection with certain coal and fuel utilization problems of particular interest to *Coal Age*. His address is Colorado Building, Washington, D. C.

DR. E. MEAD WILCOX has resigned as professor of plant pathology in the University of Nebraska and plant pathologist of the Experiment Station, effective April 1, 1920, to accept the directorship of the Agricultural Experiment Station being established at Santo Domingo in the Dominican Republic.

DR. W. S. GORTON has resigned from the Bureau of Standards, where he has been engaged in work on potential-transformer testing and automotive engine ignition, to accept a research position with the Western Electric Company in New York City.

W. ARMSTRONG PRICE, paleontologist of the West Virginia Geological Survey, is spending the winter months at Johns Hopkins University, where he is carrying on his work on West Virginia fossils through the courtesy of the geological department of the university.

THE list of British new year honors, as reported in *Nature*, includes Sir Bertrand Dawson, physician in ordinary to the king, and dean of the medical faculty of the University of London, to a peerage. Among the new knights are Professor Arthur Schuster; Dr. E. A. Wallis Budge, keeper of Egyptian and

Assyrian antiquities, British Museum; Colonel W. A. Churchman, ministry of munitions explosives department; Dr. J. Court, known by his researches on diseases of miners; Mr. F. C. Danson, chairman of the Liverpool School of Tropical Medicine; Mr. D. E. Hutchins, for his services to forestry; Mr. James Kemnal, for public services in connection with the manufacture of munitions; Mr. F. S. Lister, research bacteriologist, South African Institute for Medical Research; Mr. H. J. Mackinder, M.P., and Dr. F. G. Ogilvie, director of the Science Museum, South Kensington. Professor S. J. Chapman, joint permanent secretary, Board of Trade, and Sir Richard Glazebrook, have been promoted from C.B. to K.C.B. Dr. G. R. Parkin has been promoted to the rank of K.C.M.G., and Mr. H. N. Thompson, chief conservator of forests, Nigeria, has received the honor of C.M.G.

Professor Banti, of Florence, Dr. Van Ermengem, of Ghent, and Dr. Pawinski, of Warsaw, have been elected correspondents of the Paris Academy of Medicine.

Officers of the American Philosophical Society for 1902 have been elected as follows: *President,* William B. Scott; *Vice-presidents,* George Ellery Hale, Arthur A. Noyes, Hampton L. Carson; *Secretaries,* I. Minis Hays, Arthur W. Goodspeed, Harry F. Keller, John A. Miller; *Curators,* William P. Wilson, Leslie W. Miller, Henry H. Donaldson; *Treasurer,* Henry La Barre Jayne.

Officers of the Brooklyn Entomological Society for the year 1920 have been elected as follows:

President: W. T. Davis.

Vice-president: J. R. de la Torre-Bueno.

Treasurer: Rowland F. McElvare.

Recording and Corresponding Secretary: Dr. J. Bequaert.

Librarian: A. C. Weeks.

Curator: Geo. Franck.

Publication Committee: J. R. de la Torre-Bueno, editor, Geo. P. Engelhardt, Dr. J. Bequaert.

Delegate to Council of New York Academy of Sciences: Howard Notman.

Dr. Louis A. Bauer gave an illustrated lecture on "The solar eclipse of May 29, 1919, and the Einstein effect," at Brown University, under the auspices of the Sigma Xi, on January 15. He repeated the lecture at Columbia University, Friday afternoon, January 16. On Friday evening, February 6, he has been invited to address the American Philosophical Society in Philadelphia at the stated meeting, on "Observations in Liberia and elsewhere of the total solar eclipse of May 29, 1919, and their bearing on the Einstein theory." The address will be illustrated by lantern slides of all expeditions showing the fully developed solar corona and remarkable prominences, as well as the deflected star images.

At a meeting of the Society of Medical History of Chicago on January 17, addresses were made by Colonel Casey A. Wood, on "Walter Bailey, the first writer of an Ophthalmic Treatise in English," and by Lieutenant-Colonel Fielding H. Garrison, on "Medical Men and Music," and "Remarks on the Medical History of the War."

Professor George M. Stratton, of the University of California, is giving a series of lectures in San Francisco, during January and February on psychology and health.

UNIVERSITY AND EDUCATIONAL NEWS

The Massachusetts Institute of Technology will be administered by a special committee composed of three members of the faculty, the corporation having decided that it is not advisable to name an acting president in succession to the late Dr. Richard C. Maclaurin. This administrative committee will be composed of Dr. Henry P. Talbot, chairman of the faculty and head of the department of chemistry; Professor Edward P. Miller, head of the department of mechanical engineering, and Dr. William H. Walker, director of the newly instituted division of industrial cooperation and research. Frederick P. Fish, senior member, has been elected chairman of the executive committee of the corporation and a subcommittee, consisting of Everett Morse, Francis R. Hart and Edwin S. Webster, has

been chosen to keep in touch with the affairs of the institute and to cooperate with the faculty and officers of administration.

AT the University of California Dr. John C. Merriam, professor of paleontology and historical geology, has been appointed dean of the faculties, and Dr. A. C. Leuschner, professor of astronomy and director of the Students' Observatory, dean of the Graduate Division.

DR. JOHN M. T. FINNEY, associate professor of surgery in the Johns Hopkins Medical School, has been invited to accept the chair of surgery at Harvard University, his alma mater.

DR. HOMER L. DODGE, formerly assistant professor of physics at the State University of Iowa, is now professor and head of the department of physics at the University of Oklahoma, Norman, Okla. He has also been appointed director of the State Bureau of Standards.

MISS CATHERINE BEEKLEY has been appointed as instructor of zoology at the University of Oregon to temporarily fill the place left by Dr. C. H. Edmondson, who has resigned to take up work in the University of Hawaii.

DR. ROGER C. SMITH, of the United States Bureau of Entomology, has resigned to accept the position of assistant professor of entomology in the Kansas State Agricultural College.

DR. W. H. BROWN, formerly associate professor of botany in the University of the Philippines, has been promoted to the full professorship and chief of the department, Mr. Elmer D. Merrill having resigned to utilize his whole time in the interests of the Bureau of Science.

MR. HAROLD BOYD SIFTON, of the Seed Laboratory of the Department of Agriculture, Ottawa, has resigned to accept a position in the botanical laboratories of the University of Toronto.

DISCUSSION AND CORRESPONDENCE

OFFICIAL FIELD CROP INSPECTION

IN a recent number of SCIENCE Professor H. L. Bolley, in an article on this subject, has pointed out that until we have control of seed grain production we will continue to have mixed varieties and the best ones will continue to be lost through carelessness. Bad weeds and diseases will be spread with the seeds.

He states that "the work of each cereal crop improver and public educator on breeding dies with him," and mentions Wellman, Haynes and Saunders as examples. "Seed improvement must last through the life of many men and for this there must be plans based on established law."

I am glad to state that crop improvement associations are springing up in many states. Michigan and Wisconsin have each had an association for about ten years. During the summer (1919) there was a meeting of crop improvement association men at St. Paul, Minn. The states of Michigan, Wisconsin, Minnesota, North Dakota, South Dakota and Kansas had representatives at the meeting, showing that those states were active. Besides this we know that Ohio, Indiana, Illinois, Iowa, Nebraska and Colorado are thinking strongly of organizing crop improvement associations.

Professor Bolley, it seems, does not believe in "cooperative breeders associations." A state-controlled seed inspection under the direction of the agricultural college such as Professor Bolley advocates, will in most cases be preceded by a cooperative seed growers association. It is possible that the North Dakota work is not done by an association, as the North Dakota representatives at the St. Paul meeting were interested in alfalfa seed only, and the pedigreed seed was all sent to Fargo for recleaning. This can't be done when a state is to be supplied with pedigreed seed.

Wisconsin was the first to organize one of these associations, and now they have state aid. Most of us have not reached the stage where the lawmakers have recognized the value of a supply of pure seed, representing the highest yielding pedigreed varieties. Each of the crop improvement associations is fostered by the agricultural college of its state but can not be

an organic part of any agricultural college because the crop improvement associations are producing and selling associations.

First, before one of these associations can work, some plant breeder must have spent years purifying old varieties, or breeding up new ones. In either case the varieties to be tested must have originated from a single selected plant where thousands are usually selected and tested. The work of variety testing may continue for several years, and usually does, before a superior variety is located. The next stage is to try the new variety in various parts of the state. If it is generally found superior to local varieties it is time for an association to begin.

Thus before a crop improvement association can work, a superior variety must exist. It may have been produced in the same or another state but must have been found superior by local testing.

To distribute a new variety in small quantities without control, always means that farmers lose it by allowing it to be mixed with local varieties. The agricultural college can, with the aid of county agricultural agents, see to it that a new variety is kept pure until it leaves the farm where it is being increased. But if the grower is to continue to produce pedigreed seed and any considerable number of growers are to be interested, the producer must be able to obtain a higher price for this seed than is paid in the open market. He has seen to it that the land was free from other grains and noxious weeds. He has treated his grain for smut. He has cleaned his drill. He has pulled weeds and gone to considerable extra expense. All this trouble must be paid for. It is true that farmers are glad to grow a high-producing grain, that they may produce more bushels. They are also willing to grow a grain of higher quality if they can obtain a better price. But, as a rule, they are not willing to produce seed for other folks without a profit. They are business men not philanthropists.

To find a market for the new seed grain, there has to be a selling agency of some kind. This agency is taking the form of a crop improvement association. This is a farmers organization in every state where the movement has gone far enough to be of substantial value to the state. Usually the extension specialist in farm crops is the controlling agent. He is often the secretary of the association but not as an officer of the agricultural college. In Michigan he sees to it that the fields of grain are inspected while in head and before harvest. The farmer whose field passes inspection also submits a recleaned sample of the grain to the secretary. If his grain is acceptable the grower receives the shipping tags of the association. The grower certifies on the shipping tag that the seed conforms to the state seed laws and to the sample submitted to the association for inspection. Also if these points are not found true he agrees to refund the purchase price.

To illustrate how pedigreed grains can be taken care of, let me mention some Michigan experience. A bushel of Rosen Rye was sent to Mr. Carlton Horton at Albion in 1912. We now estimate there were 400,000 acres of Rosen Rye in Michigan in 1919. A peck of Red Rock wheat was sown by Mr. John Odell on a half of his garden patch in 1913. Mr. Odell lives about seven miles south of Allegan in Trowbridge Township. He grew 7½ bushels of Red Rock in 1914 and sowed seven acres. He had this seed for sale in 1915, but could not have interested his neighbors if it had not been for the county agricultural agent, the miller and the banker, nor could this seed have continued to be kept pure and sold for seed had it not been for the Michigan Crop Improvement Association. However, I personally inspected over three hundred acres in 1917 that contained less 1 per cent. of other varieties and almost no weeds. All this came from the peck of Red Rock sent to Mr. Odell four years before. In 1919 there were about 60,000 acres of Red Rock in Michigan. Several others of our breeding products have likewise been taken care of.

Frank A. Spragg

Plant Breeder,

Michigan Agricultural College

SCIENCE AND POLITICS

AT the St. Louis meeting of the American Association for the Advancement of Science, the council passed the following resolution:

> That sectional officers avoid placing on their programs papers relating to acute political questions on which public opinion is divided.

I know nothing of the circumstances leading to this resolution. If papers offered to the sections were inspired by partisan politics rather than by science, they would deserve condemnation and exclusion. But the resolution does not refer to such papers; it implies that scientific men should not discuss matters relating to acute political questions on which public opinion is divided. To one who believes that in the present chaos of conflicting opinions and purposes the finger of science should point the way to safety, this seems almost incredibly stupid. I am of course aware that a scientific man who tries to throw the light of truth on the field of political discussion is not unlikely to be abused for his pains. He may find honest people doubting his integrity or his intelligence. He himself is only too well aware of his liability to error. But in the face of all this, he must and should persevere, knowing well that his feet are set upon the path of progress.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO,
January 14, 1920

QUOTATIONS

THE DUES OF THE AMERICAN ASSOCIATION AND THE SALARIES OF SCIENTIFIC MEN

THE revised constitution of the American Association for the Advancement of Science, as presented at the Baltimore meeting, was adopted at St. Louis with only one substantial change—an increase of the annual dues to five dollars. This change had been recommended, after careful consideration, by the committee on policy and the council and was adopted by unanimous vote at the opening general session of the association. The increase in the dues only meets the general situation. All the expenses of the association have increased in some such proportion, except the salaries of the officers, and it would be unfair to them and a bad example to other institutions, to retain nominal salaries paid in depreciated dollars. This has been done in the case of teachers in many institutions of learning and for scientific men in the service of the government, while commensurate with the increased cost of living have been the increases in wages for many of the working classes, and of the earnings of most professional and business men.

Institutions of learning and the scientific bureaus of the government have suffered alarming losses from their staffs. At the present time many men of science are hesitating between loyalty to their institutions and research work, on the one hand, and duty to their families and the attraction of new opportunities, on the other. In one government bureau three men are now holding open offers of twenty to thirty thousand dollars a year to see whether the Congress will increase their salaries to six or eight thousand.

If men are driven away from positions where they are using their ability and their training for the general good, and if those who remain are compelled to use time that should be devoted to research or teaching to earning money from outside sources, the future of science and with it the welfare of the nation will be jeopardized. A generation might pass before there would be recovery from the resulting demoralization. It would be indeed humiliating to conquer Germany in war and then permit it to surpass us in the arts of peace.

It is certainly unfortunate that the American Association should be compelled to increase its dues, as measured in dollars, at a time when all costs are advancing to such an extent that those living on fixed salaries find it extremely difficult to make both ends meet. It would, however, be a still more serious misfortune to permit the work of the association and its publications to be crippled. These are important factors in the advancement of science and in impressing on the general public the place of science in modern civilization and the need of maintaining research work for the national welfare.

The meetings of the association and the

publications going to its members and read by a wide public are forces making for appreciation of the value of science to society and the need of giving adequate support to scientific research and to scientific men. Each member of the association contributes to this end and does his part to improve the situation for others as well as for himself. It is consequently to be hoped that no one will permit his membership to lapse on account of the necessary increase in nominal dues, but, on the contrary, that every member use all possible efforts to increase the membership of the association and to promote its influence and its usefulness.—*The Scientific Monthly.*

SCIENTIFIC BOOKS

The System of the Sciences; Principles of the Theory of Education. By Wilhelm Ostwald. The Rice Institute Pamphlet, Vol. II., No. 3, Nov., 1915.

These two lectures were prepared to be given at the inauguration of Rice Institute but the author was prevented from delivering them in person by the outbreak of the Great War. The purpose of the lectures is ambitious, being no less than to propose a fundamental system or classification for the branches of science and, on the basis of this system, to suggest a system of pedagogy which should replace, in some measure, our present system. The subjects now taught, in our universities, in particular, have grown up in an irregular, hit-or-miss fashion, especially as regards the introduction of new subjects, because "Wherever there is a gifted representative of a new discipline who is an excellent teacher and at the same time scientifically productive, he will be able sooner or later to acquire the means and influence to develop this new discipline into a recognized science." Professor Ostwald wishes to substitute for this accidental development a rational, systematic cultivation of those fields which will be most useful—presumably, though he avoids saying so directly, with the repression and discouragement of the gifted individual who does not properly fall into the scheme which has been laid down. This is scarcely in accord with that "Lehrfreiheit" of which the older Germany was so proud.

The historical method is used, in part, to discover the proper system. "All sciences in the early stages of their development formed one great whole, which, together with all other departments of human activity having to do with mental work and cogitation, was intrusted to the oversight of a single corporation—the priesthood." And so the theological faculty is the oldest—then came law—he might have said, perhaps, the Roman Law, for our modern world—and medicine. All the remaining sciences are united in the fourth, the philosophical faculty. The great technical schools form, practically, a fifth faculty, which is not, however, recognized as such.

The statement on p. 112 that "the pure and abstract sciences grow by degrees out of the applied sciences" seems scarcely consistent with the beginnings of the higher forms of knowledge in the hands of the priesthood. Nor does it agree with the development of science through such great masters as Gallileo, Newton, Boyle and Lavoisier. Applied sciences made very slow progress until men came who were interested to know the secrets of nature rather than to apply their knowledge to practical ends. The same idea is emphasized again on p. 121 in the statement that "all sciences have had their origin in the needs and desires of life." This is a utilitarian point of view which we are scarcely prepared to accept.

The over-emphasis on classical and linguistic studies is traced back to the time of the Renaissance when such studies opened to the world a wealth of material from an old and superior, but half-forgotten civilization. At such a time the exact knowledge of the languages which should bring back the old life and philosophies of the Greeks and Romans was well worth while. But now that we have developed a different and very much better civilization of our own the time devoted to classical studies can not be so well justified. It is possible, however, that the author under-

estimates the value of those linguistic studies pursued in his youth that gave to him a power to use language clearly and forcibly which it would have been difficult to acquire in any other way.

In the further discussion of language it is pointed out that the content of words which have grown up in the usual manner, through long use, is often vague. This and other considerations lead the author to advocate the use of an artificial, general language with accurately defined words. Such a point of view overlooks the fact that many of the words of our mother tongue carry in themselves delicate shades of meaning which represent our memory of their use in a great variety of connections. Such words can not be successfully replaced by words of a foreign tongue, still less by the words of an artificial language.

In classifying the sciences the simplest and most general ideas came first. These embrace logic or *relationships,* mathematics, or numbers, order, form and quantity, and the science of time, for which there is no distinctive name. The second division, *energetical sciences.* includes mechanics, physics and chemistry. These use the concepts and principles of the first division while the sciences of the first division are, in an important sense, independent of either of the others. The third division, the *biological sciences,* is divided into physiology, psychology and "culturology."

Thus far the divisions of human knowledge and the pedagogical sequences based upon them may be accepted as useful and there is very much of sound common sense in the discussion. But very many will object to the complete omission of any direct reference to moral and religious education, and to his treatment of the child as merely an "energetical machine" (p. 202). On p. 120 the author says; "We shall renounce in any scientific system the consideration of all supernatural relationships of whatever nature, and, on the other hand, we shall extend our scientific problems to each and every field of human experience." If by "supernatural relationships" is meant some one who interferes occasionally and irregularly and capriciously in human affairs, the large majority of scientific men will agree. But if Professor Ostwald means that there is no "Power not ourselves which makes for righteousness" many of the leaders both in England and in America will dissent most strongly. In remembrance of the bitter controversies of the past, we are wont to be very silent about questions of this kind, but to very many it is simply unthinkable that the orderly universe in which we find ourselves is merely the blind resultant of the interaction of matter and energy without some intelligence which is in and through it all.

Somewhat related to his philosophy is Professor Ostwald's statement (p. 206) of "the most general problem of every human life" as "the attainment of happiness." He recalls his former conclusion that "the most important requisites for happiness are, first, the greatest possible amount of completely transformable free energy, and, secondly, the greatest possible amount of energy transformed voluntarily." It is very interesting to notice the naïveté of the last phrase. Anything done "voluntarily" is either a self-deception or it is in flat contradiction with a materialistic or mechanistic philosophy. But there is no mechanistic philosopher who does not act as though he considers himself, practically, a free agent.

The definition of the conditions of happiness is incomplete in a still more important respect. It overlooks the fact that in matters of happiness "he that saveth his life shall lose it." Happiness is not found best by seeking it *directly.* We condemn and despise the man who makes his own personal happiness or even the personal advantage of his family the supreme object of his life. The great men of the world have risen far above such considerations. The time is coming when the class, or community or nation which considers its own advantage as paramount to that of all others will also be condemned. Indeed, the execration which Germany has brought upon herself from the whole world was chiefly due

to her supreme national selfishness. Unfortunately, some of the nations which have condemned her so unsparingly are not free from the same fault.

As so often happens, Professor Ostwald is very much better in his conduct as a man than his philosophy might lead us to expect. In these days of international bitterness and hatred, it is worth while to recall an incident of the St. Louis Congress of Arts and Sciences. Professor van't Hoff gave an address in which he presented a masterful sketch of the historical development of chemistry, especially from the point of view of the atomic and molecular theories. In the course of the address he wrote on the blackboard the names of some of the great leaders in chemistry—such names as Dalton, Dulong and Petit, Pasteur, La Bel, Guldberg and Waage, Curie and others. At the close of the address Professor Bancroft, who was in the chair, called on Professor Ostwald. Those were the days when Ostwald and some others wished to find some way to get on without the atomic theory. He began his talk with a very kindly criticism of the address in which he proposed to substitute "energy" for "atoms" and suggested that at the hands of the Curies atoms had "exploded." Then he picked up a piece of chalk and saying "I have still another correction to make" he wrote in the name of van't Hoff at three different places among the great names on the board and in each case those who were present recognized instantly that van't Hoff, in three widely separated fields, had done work of the same fundamental and far-reaching importance as the work of the other men. It is the kindly, generous spirit shown in this incident which endeared Professor Ostwald to his students and to many others with whom he came in personal contact.

The suggestions with regard to students helping each other with their tasks are novel and striking. "It is considered at present one of the worst offenses for one child to help another solve its task. *Is, then, mutual willingness to help a characteristic so exceedingly general that it must be systematically done away with in school?* Is not, rather, egoism and narrowmindedness a fault under which we suffer severely? I do not hesitate to express the conviction that a considerable amount of this illiberality is imparted to our growing youth in school by the prevalent notions regarding this mutual help and the usual treatment of it." So far, good, and worthy of consideration in our treatment of children and of students. But the corollary is not so good—"others learn at an early age that in their advancement they have need of the assistance of better endowed ones, and, what is the best thing for all of them, they learn subordination and how to work in rank and file"—a picture of a world where some are born to rule and others to be ruled. How different from the democratic ideal, where these same differences still exist and always will exist, but where men should work together, not as superior and subordinate, but each according to his ability, for the common good.

We can not take the space for a more detailed criticism of the addresses. While the author of this review dissents most earnestly from a part of the philosophy which lies at the foundation of the papers, there is very much in them which is sound and worthy of most careful study.

William A. Noyes

SPECIAL ARTICLES

DROUGHT AND THE ROOT-SYSTEM OF EUCALYPTUS

In the fall of 1913 the eucalyptus trees, especially the *Eucalyptus globulus* in the Arboretum of Stanford University, were evidently dying. Various persons questioned the members of the Department of Botany here as to the reason for the grave appearance of these large trees and none of us was able to give an answer satisfying to himself. For this reason we undertook to determine the cause of the trouble.

By permission of the business office we tapped various trees with an auger to the heart and found that the wood and bark were entirely free from disease of any sort. The

trouble manifested itself in the change of color of the foliage, the leaves turning brown as if burned or killed by frost, and drying out and presently beginning to fall. The leaves which fell showed no sign of fungus or bacterial infection. We were therefore forced to conclude that the trouble was further down and we were compelled by the condition of the trunk to suspect that the difficulty was either between the trunk and the leaves or below ground. As we had no convenient means of climbing the trees to make any examination of the branches, we concluded to look at the roots first.

By laying bare the more superficial part of the root system with pick and shovel, we found that the large superficial roots had been broken through at various distances from the trunk by the heavy plows which, up to that time, had been used in the spring, for a number of years, to clear the ground under the trees of weeds. The deep ploughing had resulted in the serious injury, the wounding or amputation, of all the roots to a distance of twelve or fourteen inches below the surface. In this way the roots, absorbing moisture from the upper layers of the soil, were either very seriously limited, or absolutely destroyed, as regards their capacity for absorbing water; and the soil water supply of these trees came therefore through the taproot or its deeper branches and from the branches running vertically downward from the underside of the uninjured lateral roots, from distances below the surface, of which we have no means of knowing anything. Whether one half or what other proportion of the absorbing surface of the root was thus destroyed we also have no means of knowing. The condition of the roots led us to suspect that this might be the cause of the condition, deplorable in appearance, of the blue gum trees throughout the Arboretum.

We were confirmed in this suspicion by examining the root system of the Monterey cypress (*Cupressus macrocarpa*) tree growing close to the big eucalyptus tree previously examined. We were interested to find that the horizontal roots of the Monterey cypress grew enough deeper in the soil entirely to escape the heavy plows which had wounded or amputated the roots of the eucalyptus. This Monterey cypress tree presented none of the deplorable features of the eucalyptus trees, for although its foliage was dusty, it was green and far from dying. We therefore concluded that the trouble with the big blue gum trees of our Arboretum was lack of water, due to an impaired root system.

That this suspicion was justified we believe is confirmed by two additional observations. Many of the eucalyptus trees which were evidently dying, as indicated by the brown color of the leaves, were cut down. Those that were cut down early enough, promptly stump sprouted, and have since grown up into promising young trees, borne on the old butts. By thus drastically reducing the evaporating surface, the water absorbed by the roots was conserved and the quantity became immediately adequate to meet the loss. Additional confirmation of our suspicion has been furnished during the last two years.

In the winter of 1917–18 there fell in Palo Alto scarcely more than eight inches of rain. In the following autumn there was no sign of injury among the eucalyptus trees, of which there were still many in the Arboretum. To be sure, many of the larger and finer had been cut five years earlier, but enough were left to show damage if the damage had been present, for the rainfall in the rainy season of 1917–18 was about an inch less than in the fifth year preceding. Furthermore, although the rainfall in Palo Alto in the rainy season of 1918–19 was approximately twenty-three inches, there has been practically no rain since early March until late September; and there is not yet a total of one inch of rain in the immediate vicinity of the Arboretum, though there is no sign of drought among the eucalyptus trees.

The manner of keeping down the weeds in the Arboretum, however, has been changed, since our observation of the injury due to deep ploughing, and the disk harrow or spring tooth harrow are all that are used for cutting down and keeping down the weeds which are

necessarily numerous on the floor of an open woods like our Arboretum. The necessity therefore of protecting the superficial parts of the root system, even of a deep-rooted tree like blue gum is perfectly obvious from the foregoing description.

One more conclusion can be drawn from these observations. The Monterey cypress above referred to, was growing at no great distance from the eucalyptus trees but was in no wise impoverished by its more rapidly growing neighbor. There is a general impression, based no doubt on a certain amount of accurate observation, that the eucalyptus is a bad neighbor and that trees, shrubs, and herbaceous plants set too close to eucalyptus trees will suffer for lack of water. The above observation shows that if the plants set near eucalyptus have the habit of sending their roots lower than the superficial part of the root system of the eucalyptus, such results will not follow.

Therefore, it would seem to be possible, notwithstanding general belief to the contrary, to plant trees and shrubs fairly close to eucalyptus providing they can get along with the amount of light which the growing eucalyptus will keep from reaching the surface of the soil. This may make possible the fuller utilization of areas of soil already carrying a certain number of eucalyptus trees.

James McMurphy,
George J. Peirce

Stanford University,
November 1, 1919

THE MATHEMATICAL ASSOCIATION OF AMERICA

The fourth annual meeting of the association was held at Columbia University on Thursday and Friday, January 1 and 2, 1920. A joint dinner with the American Mathematical Society occurred on Wednesday evening. About 150 were in attendance at the various sessions.

The general topic for all sessions was "Mathematics in Relation to the Allied Sciences." The program was as follows:

"Mathematics for the physiologist and physician," Dr. Horatio B. Williams, assistant professor of physiology, College of Physicians and Surgeons.

"The regular solids and the types of crystal symmetry," Dr. Paul L. Saurel, professor of mathematics, College of the City of New York.

"The mathematics of physical chemistry," Professor George B. Pegram, dean of the school of mines, engineering and chemistry, Columbia University.

"The mathematics of biometry," Dr. Lowell J. Reed, associate professor of biometry and vital statistics, Johns Hopkins University.

"An experiment in the conduct of freshman mathematics courses," Dr. F. B. Weley, professor of mathematics, Denison University.

Preliminary report of the National Committee of Mathematical Requirements, Dr. John W. Young, professor of mathematics, Dartmouth College.

"Mathematics for students of physics," Dr. Leigh Page, assistant professor of physics, Yale University.

At the business meeting the election to membership by the council of 73 persons and two institutions was announced. The treasurer's report showed receipts of $4,728 on 1919 business, expenditures (up to December 15, 1919) of $4,317, and an estimated final balance of $2,050 for the end of the year 1919.

The result of the election of officers was as follows:

President: David Eugene Smith, Columbia University.

Vice-presidents: Helen A. Merrill, Wellesley College, and E. J. Wilczynski, University of Chicago.

Additional members of the Council (to serve until January, 1923): R. D. Carmichael, University of Illinois; E. R. Hedrick, University of Missouri; H. E. Slaught, University of Chicago, and J. W. Young, Dartmouth College.

To fill the vacancies caused by the election of Professor Wilczynski to a vice-presidency and the reappointment of Professor Slaught as manager of the *Monthly*, the council appointed as members of the council E. L. Dodd, University of Texas, and Oswald Veblen, Princeton University.

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